Conversive: Bringing In-context Discussions to Online Video Lectures with Anchored Video Comments

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ABSTRACT

Online video learning through Massive Open Online Courses (MOOCs) currently does not afford the same in-context discussions as classroom learning. Discussion forums are separate from online videos, and discussion engagement around videos is often low. We introduce *Conversive*, a web tool that brings the advantages of in-context discussions to online video learning by integrating the online video lectures with a discussion forum. Students can see other students' comments at the same time in the video during which they were written, enabling in-context discussions directly related to the video content being watched. An evaluation of Conversive was conducted with a live MOOC class, which demonstrated increased discussion and engagement. Furthermore, a survey indicated a strong preference in favor of the Conversive interface over the existing, detached discussion forum. With Conversive we extend previous work done in static document annotation to the medium of online video, build and test the system in a real classroom context and discuss ideas for a system to handle MOOC's unique scale.

Author Keywords

Online education; massive open online course; discussion forum.

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: User interfaces; K.3.1 Computers and Education: Computer uses in education

INTRODUCTION

The most impactful interactions in classroom learning are often in class where students ask questions and discuss concepts during a lecture as they are being taught. These live interactions allow in-context topic discussions and real-time clarifications. While Massive Open Online Courses (MOOCs) have become an important medium for large-scale learning, a major disadvantage is that their current format does not allow for the same in-context questions and answers that classroom learning affords.

The unique characteristics of MOOCs—for example the massive number of students in one class, the asynchronicity of watching lectures, and the lack of in-person real-time communications—lead to design challenges regarding content discussion.

In this paper we present Conversive, a system that brings the advantages of classroom-like in-context discussions to MOOCs. Conversive allows students to engage in discussions as they watch the online video lectures, combining the video playback and discussion forums into one integrated system. Conversive uses two interfaces for this purpose: a lecture timeline that shows what sections of the video are being discussed at a glance, and a comment feed next to the video that dynamically visualizes discussions relevant to the current video section.

Much research has been done in facilitating discussions in MOOC systems, but none have yet to study the effects of highly integrated online video discussions. In addition, compared to other document annotation research [1, 6], Conversive adds in-context embedded discussions to the medium of online video. We also discuss the implications of handling this medium and the unique scale of MOOCs.

This paper makes the following contributions:

- The design and implementation of the system (Conversive) for enabling in-context discussions around online video. A novel feature of this is the anchoring between the comments and the video, allowing students to visualize what parts of the video are being discussed and easily jump to relevant times in the video using our timeline visualization. The design also included technical features required to enable such a system to scale to thousands of students without overwhelming the forum.
- An evaluation of the Conversive system on a real MOOC class setting, and a comparison of our system and the MOOC's original forum-based discussions, measuring engagement and participation in both creating and viewing discussions. The results showed that students using our system had better discussion engagement than those using the traditional MOOC forum.
- Conducted a survey study with students who used Conversive to get a more subjective evaluation of the usefulness of the system. The results suggest that a majority of students saw the benefit of in-context discussions and preferred the Conversive system to the separate forum based discussions.

RELATED WORK

We discuss our work is original relative to prior work in crowd document annotation as well as prior work in improving MOOC discussion engagement.

In-context Group Document Annotation

Ackerman et al. [6] and Brush et al. [1] both showed a digital group discussion system based around the web and PDF

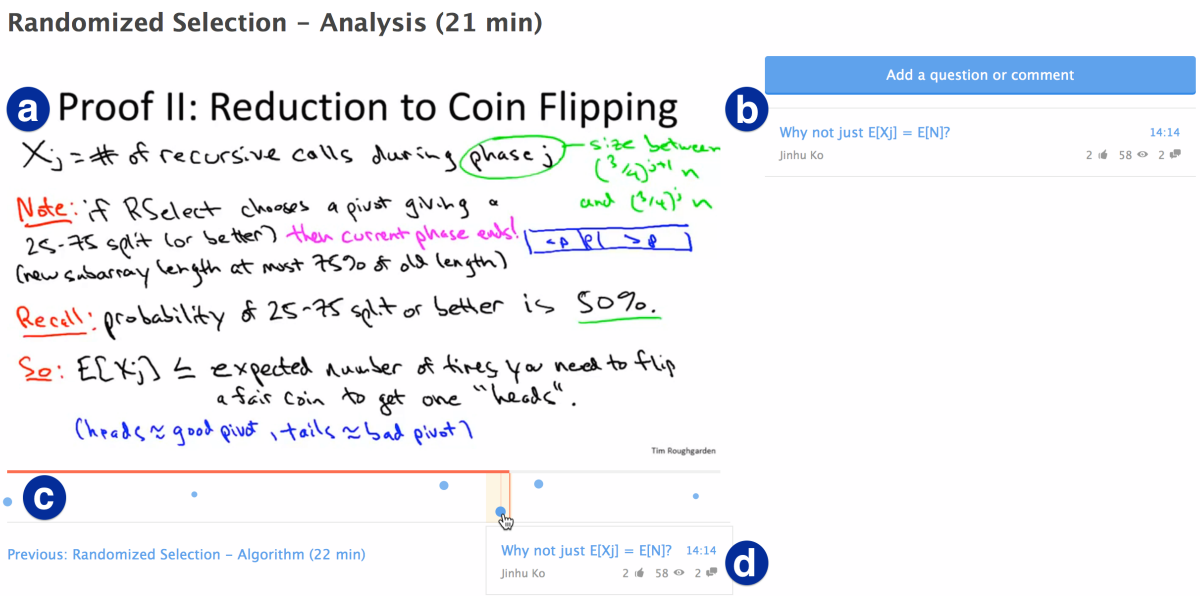

Figure 1. The main view for Conversive showing (a) the embedded video lecture. (b) The sidebar exposes the primary call to action button for posting new topics and dynamically shows posts from current section of the video. (c) The timeline (doubling as a progress bar) shows all posts for this lecture represented by different-sized dots, while highlighting the two posts currently shown. (d) Tooltip is shown on hover over timeline dot visualization.

documents, which showed increased engagement compared to standard out-of-context forum discussions. While these physically placed annotations near the subject matter (e.g. in margins next to text), the limited affordances of a text document format prevented exposing only highly relevant and granular information at the time of consumption. We built on their findings to test how different interfaces (timeline visualization and feed based discussions) can elicit different behaviors while also furthering their concepts to manage the unique scale of MOOCs, which requires functionality that filters and seeds discussions before showing them to the entire audience.

Improving Online Video Interaction and Engagement

Cambre et al. [2] demonstrated an online platform to enable diverse peer interaction in MOOCs, resulting in increased engagement and higher scores on course content. Carr-Chellman et al. [3] similarly recommended facilitating online, asynchronous student interactions for large-scale, distance educations as a way to unlock powerful learning opportunities in this medium. Both of these motivate increasing student dialogue in MOOCs, but our system integrates these discussions within the video viewing context and present relevant information in real-time, as would occur in a physical classroom. Relevant to introducing discussions to online video lectures, Weisz et al. [4, 5] discuss the benefits and challenges of integrating real-time chatting to online video watching. Our system differs from this as students can have discussions in the context of the video, but not need to be viewing the video at the same time.

DESIGN GOALS

We approached our design with the goal of furthering the work of Ackerman et al. [6] and Brush et al. [1] by building such a system for online video content and investigating how this medium requires a different system to manage the affordance of video content as well as the unique scale of MOOCs. Our goal was to build a system that better enables in-context discussions resulting in better engagement from students and to also measure the use of this system as compared to current systems.

We therefore had the following design goals for the Conversive system:

- Enable participants to engage in in-context discussions around online video lectures. This includes making the context of any discussion quickly accessible and also showing any comments or questions in the temporal context of the video while it is being watched.
- Enable participants to easily visualize what sections of the video were being discussed. This allows students to focus on the hotly discussed sections of the video without sifting through a feed based list of comments.
- Make it easier for participants to engage in discussion (view and post comments) as compared to the MOOCs traditional forum baseline. This includes getting more participants to both view posts that have been written and also add their own questions of comments.
- Minimize distraction from learning experience. The large size of MOOC classes introduces the problem of the sheer volume of discussion that would be overwhelming and distracting. We aimed to improve engagement in discussions but not at the cost of being overly distracting.

CONVERSIVE

Conversive allows inline class discussion within the students' video lecture viewing experience, and implements visualizations and interactions designed to increase engagement. The

screenshot of the system's primary interface is shown in Figure 1. We define two types of posts on Conversive: *topics* and *comments*. Each topic is a discussion thread which is linked to a time in video, whereas each comment belongs to a topic.

When a student starts watching a video lecture(Figure 1a), the post topics anchored to the current time slice dynamically appears on the right-hand sidebar (Figure 1b). These topics present metrics like upvotes, view counts, and number of comments that help quickly reveal popularity and relevance to the viewer, as well as a clickable anchor time that jumps to that point of lecture. Clicking the topics expands the discussion and enables adding additional comments. The sidebar also contains a prominent call to action button at the top ("Add a question or comment") which pauses the video and allows the user to easily post a new topic, henceforth immediately viewable by other students watching this lecture time slice.

Immediately below the video, a timeline progress bar visualizes all posts related to the current lecture at a glance (Figure 1c). Dots are sized according to their helpfulness (number of upvotes) and placed along the x-axis according to the time they are anchored. When a user hovers the cursor over a dot, a tooltip appears at the bottom (Figure 1d) which contains the topic title and its relevance metrics. Clicking on either the dot or the tooltip jumps to that lecture time and opens the post topic discussion for viewing and contribution.

All interactive elements on Conversive were built using client-side javascript. Video lectures were embedded using a customized Youtube player. We used Firebase[1], a realtime cloud data store, as our backend.

EVALUATION

The purpose of the evaluation is to gauge the helpfulness of in-context discussion in video lectures, and assess the usability of the system. We ran experiments on students of a popular, active Coursera[2] course, and conducted a follow-up survey study. In this section, we describe the experiment, analyze user engagement data, and evaluate the follow-up survey results.

Method and Participants

The course we experimented on is the Spring 2014 session of *Algorithms: Design and Analysis, Part 1*[3], which started on April 28, 2014. With the permission of the course instructor and the Office of the Vice Provost for Online Learning at Stanford, we hosted two of the course videos, *Randomized Selection - Algorithm* and *Randomized Selection - Analysis*, in the Conversive system on a Stanford domain. The course instructor informed his students in a weekly update email about this experiment, and asked the students to participate voluntarily. The email was sent at the beginning of the week when the two videos were made public.

Users who came to Conversive are first asked to register. In the registration form, we asked participants to fill out a short survey which asked about gender, age, percentage of video lectures watched, and number of posts created on the Coursera discussion forum of this course. After registration, they can watch a video explaining what Conversive is and how to use it[4].

Before the experiment started, we created a welcome message at the beginning of each video in the form of a topic and a comment, which welcomes the users and explains briefly the purpose of the system. We also seeded 5 questions in the second video, which were taken from the Coursera forum of a previous offering of this course, and posted using fake user names.

The experiment ran for 10 days, and received 158 registered users in total (27 female). According to the pre-experiment survey, participants ranged from 17 to 78 years of age with an average age of 30.9 and median of 28. 102 of the registered users watched at least one video on Conversive (14 female).

User interaction	Number of times	Average number of times per user
Create new topic	8	0.0784
Create new comment	21	0.206
Open topic from list	103	1.01
Open topic by clicking on dot visualization	157	1.54
Open topic by clicking on tooltip	31	0.304
Mouse over dot visualization	547	5.36

Table 1. User engagement breakdown on Conversive.

User Engagement Data Analysis

We logged all user activity on Conversive during the experiment. Table 1 presents part of the logged data. Note that in the number of created topics and comments, we have excluded those created by us prior to and during the experiment. We have also excluded the interaction generated by us prior to and during the experiment.

We analyze the user engagement data on Conversive and compare it to Coursera forum of a previous offering of the course. The July 2013 session of the same course had exactly the same videos that we hosted on Conversive. During that session, 11,153 students watched the first video on Coursera, and 10,459 students watched the second. In comparison, 93 students watched the first video on Conversive, and 48 watched the second. Table 2 summarizes the comparison.

Before the analysis, we first define the interactions on Coursera discussion forum and on Conversive:

- *Engaging in the Coursera forum discussion of a video* means that the student either created at least one thread in the Coursera forum about the content of the video lecture, or posted at least one reply to a thread about the content of the video lecture.

[1] `https://firebase.com/`

[2] `https://www.coursera.org/`

[3] `https://class.coursera.org/algo-005`

[4] `http://youtu.be/pVkCXOn4Cp0`

	Video 1		Video 2	
	Conversive	**Coursera**	**Conversive**	**Coursera**
Number of people who watched the video	93	11,153	48	10,459
Number of people who engaged in forum discussion	11	3	5	12
Number of posts created (topics and comments)	22	4	7	23
Number of thread views	155	41	136	298

Table 2. User engagement compared to Coursera.

- *Engaging in Conversive discussion of a video* means that the student either posted at least one topic in the video lecture, or posted a comment to a topic in the video lecture.
- *Viewing a Coursera forum thread* means that the student clicked into the thread in the Coursera forum.
- *Viewing a discussion thread on Conversive* means that the student clicked into the topic by (a) clicking on a topic in the topics list, (b) clicking on a dot visualization, or (c) clicking on the tooltip after hovering a dot visualization.

One of the design goals of Conversive is to spark more discussion about the video lectures. On the Coursera forum of the June 2013 session, 3 students engaged in the discussion of the first video, and 12 students engaged in the discussion of the second video. Significantly more students engaged in the discussion on Conversive. 11 students engaged in the discussion of the first video on Conversive ($p < 0.0001$), and 5 students engaged in the discussion of the second ($p < 0.0001$).

Conversive also aims at making the discussion more accessible and reach more students in MOOCs. On the Coursera forum of the June 2013 session, the forum threads related to the first video were viewed 41 times in total (averaging 0.00368 times per student who watched the video), and those related to the second video were viewed 298 times (0.0285 times per student). In comparison, the discussion threads of the first video on Conversive were viewed 155 times in total (1.67 times per student), and those of the second video were viewed 136 times in total (2.83 times per student).

We now examine the user engagement that is unique to Conversive. We see from Table 1 that a good portion of interaction came from the visualization. Out of all the thread views on Conversive, 64.6% were done by clicking on either dot visualization or the tooltip. Moreover, each student hovered on the dot visualization with the mouse 5.36 times on average.

Survey Results Evaluation

After the experiment was concluded, we sent out a survey to all the users who watched at least one video. The survey asks about their previous usage of Coursera forum, helpfulness of Coursera forum and Conversive, subjective comments on Coursera forum and Conversive, and whether or not they would prefer Conversive over Coursera forum. We received 8 responses in total.

Participants were asked to rate the helpfulness of the video lecture section of Coursera forum, the in-context discussion design in Conversive, and the visualization design in Conversive. Responses were given in a 5-point Likert scale, with an option to skip the question if the participant finds it irrelevant (never used the Coursera forum, was not aware of the in-context discussion feature, or was not aware of the visualization, respectively). Figure 2 summarizes the responses to these questions. All valid responses either agree or strongly agree that both the in-context discussion feature and the visualization in Conversive are helpful. In comparison, 42.9% of all valid responses either disagree or is neutral that Coursera forum is helpful. The rated helpfulness of in-context discussion design is significantly higher than that of Coursera forum (4.57 vs. 3.57, $p = 0.035$). The rated helpfulness of the visualization is also higher than that of Coursera forum, but not significant (4.43 vs. 3.57, $p = 0.064$).

Some respondents identified that the Coursera forum is disconnected from the video lectures. For example, one participant said:

> *"(I dislike Coursera forum because of) the very fact that you have to specifically go to the lecture discussion forums. I liked Conversive as it was much more of a real time experience."*

Many respondents expressed a good understanding of the in-context discussion concept, and some said that Conversive simulates a in-class discussion:

> *"Its an awesome idea...this way your questions can be precise and easy for others to answer as you dont have to explain the context.."*

> *"(The discussion is) really nicely incorporated into the video and makes the experience much more wholesome, it's just like attending a class at the university."*

The feedback on the timeline visualization brought up an unexpected point. 3 respondents mentioned that having the timeline visualization lets them know which part of the video deserves more attention, for example:

> *"I think it grabs your attention to when you should focus more on the lecture or on the discussion, to sort of prepare yourself mentally for the argument and to really grasp the point being made in the video"*

The final section of the survey is about general feedback to Conversive. All survey respondents answered *yes* to the question *"Would you prefer Conversive over the Cousera Video Lecture forums?"* One participant said:

> *"I think this is a game changer for online classes. I feel like I can engage with the lecture a lot more as well as with other students."*

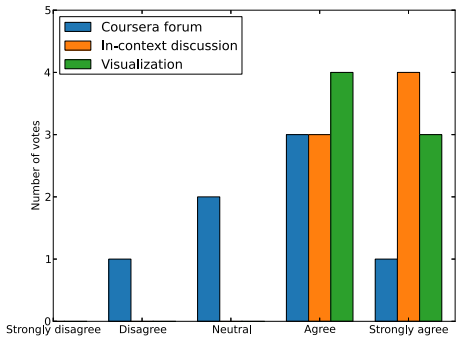

Figure 2. Reported helpfulness of Coursera forum compared to in-context discussion and visualization in Conversive.

Participants also pointed out the downsides of Conversive and potential issues if Conversive is deployed at scale. For example, participants mentioned that they *"don't like the small screen"*, and that it *"may disturb students."* We will discuss potential improvements in design to solve such problem in the following section.

FUTURE WORK

While Conversive was deployed and shared with thousands of students in an active Coursera class, our desire to minimize disruption to the ongoing learning experience for students limited the study to a small, though still significant, group of about 150 students who proactively opted to use our system. A more controlled, rigorous experiment that samples among a wider range of student population would strengthen our findings to be applicable to a more general audience.

While Conversive was designed to scale to large audiences, further research is needed to test out effective visualization and thresholding mechanisms to best suit a typical MOOC size of thousands of students. For example, we considered various approaches for visualizing the list of topics shown in a given lecture segment in cases where topics are too numerous to show in the main screen. A real deployment would require careful tuning to show the most relevant and helpful posts (e.g. highest rates of upvotes, click-throughs, and comments) while also allowing new posts to be promoted. In our deployment, no single video segment contained more than two topics by users.

We also received user feedback suggesting a few UI design and feature changes that may help improve the Conversive experience. Larger video size and allowing playback speed, as well as the ability to subscribe to topics and get email notifications of updates or replies were the major suggestions. As future research, we could explore different interfaces such as hiding or moving the sidebar discussion panel to the bottom of the screen, which may be toggled based on user preference for students who do not wish to constantly view posts from other students.

Finally, further investigation is needed to maximize benefits inherent in the affordances of video content alongside discussion posts. For example, lectures could be paused for posts deemed "critical" by the staff or other students to ensure every student sees them, while also allowing opt-out for such features. Other examples are having staff or moderator posted content that is visualized differently from normal student posts, or allowing video responses from instructors integrated into the original video lectures.

CONCLUSION

In this paper, we explored a novel solution to the problem faced by MOOCs of low student discussion and engagement relative to traditional classroom settings. We introduced Conversive, a scalable online video lecture system that integrated interactive discussion forums alongside video lectures. Our findings from deploying Conversive to over 150 students as an alternative to a popular Coursera class suggest that Conversive significantly increased discussion and engagement. Further, qualitative data suggest that participants have a marked preference for the Conversive interface over the existing, detached discussion forum format.

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